

CLAIMS

1. A method for forming a semiconductor device, the method comprising:
5 providing a semiconductor substrate;
 forming a stack over the semiconductor substrate;
 forming an insulating layer over the stack; and
 implanting through the insulating layer and into the semiconductor
 substrate to form an implanted region, wherein the implanted region is
10 part of a current electrode.
2. The method of claim 1, wherein forming the insulating layer further
comprises forming an insulating layer comprising nitrogen.
- 15 3. The method of claim 1, wherein forming the insulating layer further
comprises forming a layer comprising silicon and nitrogen.
4. The method of claim 1, wherein forming the insulating layer further
comprises forming a layer devoid of silicon dioxide.
- 20 5. The method of claim 1, wherein providing the semiconductor substrate
further comprises providing a semiconductor substrate comprising silicon.
6. The method of claim 1, wherein forming the stack further comprises:
25 forming a gate dielectric over the semiconductor substrate; and
 forming a gate electrode over the gate dielectric.

7. The method of claim 6, wherein forming the stack further comprises forming a capping layer over the gate electrode.

5 8. The method of claim 7, further comprising removing the capping layer after implanting.

9. The method of claim 1, wherein forming the insulating layer over the stack further comprises forming the insulating layer in contact with the
10 semiconductor substrate.

10. The method of claim 9, wherein forming the insulating layer in contact with the semiconductor substrate further comprises forming a nitride layer in contact with the semiconductor substrate.

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11. The method of claim 1, further comprising:
forming a first spacer over the insulating layer; and
forming a heavily doped region adjacent the first spacer.

20 12. The method of claim 11, further comprising removing the first spacer after forming the heavily doped region; and wherein: implanting through the insulating layer and into the semiconductor substrate to form an implanted region is performed after removing the first spacer; and the implanted region comprises an extension region.

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13. The method of claim 11, further comprising forming a second spacer;
removing the second spacer; and wherein: forming the insulating layer over the
stack is performed after removing the second spacer; and
the implanted region comprises an extension region.

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14. The method of claim 11, wherein:
forming the insulating layer over the stack further comprises forming the
insulating layer before forming the spacer; and
the implanted region is an extension region.

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15. The method of claim 11, wherein forming a heavily doped region adjacent
the spacer further comprises forming a doped epitaxial region.

16. A method of forming a semiconductor device comprising:

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providing a semiconductor substrate;
forming a stack over the semiconductor substrate;
forming an insulating layer over the stack and the semiconductor substrate;
implanting through the insulating layer and into the semiconductor
substrate to form an extension region;

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forming a first spacer over the semiconductor substrate; and
forming a heavily doped region adjacent the first spacer.

17. The method of claim 16, wherein forming the insulating layer further
comprises forming a layer devoid of silicon dioxide.

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18. The method of claim 16, wherein forming the first spacer is performed after forming the insulating layer.

19. The method of claim 18, further comprising:

5 removing the first spacer before implanting through the insulating layer; and forming a second spacer after implanting through the insulating layer; wherein forming the heavily doped region is performed before removing the first spacer.

20. The method of claim 16, wherein forming the first spacer is performed
10 before forming the insulating layer.

21. The method of claim 20, further comprising:

removing the first spacer before forming the insulating layer; and forming a second spacer after implanting; and wherein forming the heavily
15 doped region is performed before forming the insulating layer.

22. The method of claim 16, wherein forming the insulating layer further comprises forming an insulating layer comprising nitrogen.

20 23. The method of claim 16, wherein forming the insulating layer further comprises forming a silicon nitride layer.

24. The method of claim 16, wherein providing the semiconductor substrate further comprises providing a semiconductor substrate comprising silicon.

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25. The method of claim 16, wherein forming a stack further comprises:

forming a gate dielectric over the semiconductor substrate; and
forming a gate electrode over the gate dielectric.

26. The method of claim 21, wherein forming the stack further comprises
5 forming a capping layer over the gate electrode.

27. The method of claim 26, further comprising removing the capping layer
after implanting.

10 28. The method of claim 16, wherein forming the insulating layer over the
stack further comprises forming the insulating layer in contact with the
semiconductor substrate.

29. The method of claim 16, wherein forming the insulating layer in contact
15 with the semiconductor substrate further comprises forming a nitride layer in
contact with the semiconductor substrate.

30. A method of forming a semiconductor device, the method comprising:
providing a semiconductor substrate;
20 forming a stack over the semiconductor substrate;
forming an insulating layer over the stack and the semiconductor substrate;
implanting an extension region through the insulating layer and into the
semiconductor substrate;
forming a spacer adjacent the stack and over the insulating layer;
25 removing a portion of the insulating layer over the semiconductor
substrate; and

forming a heavily doped region within the semiconductor region and adjacent the spacer.

31. The method of claim 30, wherein forming the insulating layer further
5 comprises forming a layer devoid of silicon dioxide.

32. A semiconductor device comprising:
a semiconductor substrate;
a stack over the semiconductor substrate, wherein the stack has a first
10 sidewall and a second sidewall;
an insulating layer overlying the first sidewall and the second sidewall of
the stack, wherein the insulating layer is devoid of silicon dioxide.

33. The semiconductor device of claim 32, wherein the insulating layer
15 comprises nitrogen.

34. The semiconductor device of claim 32, wherein the insulating layer is a
material selected from the group consisting of silicon nitride and hafnium
oxide.

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